TITLE Remote Sensing Geophysics from Skylab

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1. A rationale has been proposed by Gary Raines which provides a conceptual frame for selecting and studying ratioing-type algorithms to enhance multispectral data. The rationale defines a simple ratio of two channels as a slope measure in 2-space. Having derived a rationale for two and three channels with an associated geometric presentation, it can be generalized to n channels; thus providing a method for selecting and studying enhancement algorithms using n channels.

The 2-space model, two channels, is based on a previous study (Vincnet, 1972) which describes the spectral signals of a ground target at a multispectral scanner. The simplest case of the 2-space model assumes that an accurate atmospheric correction can be made and that the irradiance on the target and the atmospheric transmission are the same for the two channels. A ratio of the two channels is then the ratio of the target reflectance in the two channels. The ratio may result in separation of the targets in 2-space that does not occur in any single channel.

Making the same simplifying assumptions for 3-space, we can say that the ratios defining the three slopes of the vector from the origin to a data point are the 3-space equivalents of the 2-space ratio. One geometric representation of the 3-space model is that the ratio may result in separation of the targets into regions each including different targets that can be separated by a plane or planes.

This model can then be generalized to n-space. The general equation is as follows.

$$\text{ratio} = \frac{x_i}{\left[\sum_{\text{All } j \neq i} x_j^2\right]^{\frac{1}{2}}}$$

x_i = multispectral signal for channel i.

For the n-space model, cluster analyses, which indicate that targets are separable, supplies a technique for selecting which ratios to use. For the 2-space model, cluster diagrams in the various 2-spaces may be inspected to select appropriate ratios; however for 3-space, there is a perspective-view problem that has to be taken account of in order to inspect the clusters. Once useful ratios have been selected the ratioed data and the cluster diagrams can be analyzed to define the best manner in which to diaplay the ratioed data for interpretability by an experienced image interpreter.

If the simplifying assumptions concerning the irradiance and the atmospheric transmission can not be made, then cluster analysis of the raw data could suggest useful transforms for discrimination of the targets. (Report by Gary Raines)